What is claimed:

1. A method of friction welding first and second parts together having a specific axial orientation relative to each other in which said first part is mounted to a spindle for axial rotation said second part is mounted to a non-rotatable holder moveable toward said spindle along the axis of rotation of said first part, comprising the steps:

a. causing said spindle and mounted first part to be rotated at a desirable speed while determining the angular axial orientation of said first part relative to said second part at any specific time,

b. moving said holder toward said spindle to bring said second part into frictional contact with said first part at a selected one said specific time to cause heating of said first and second parts and the melting of the respective contacting surfaces thereof,

c. then decreasing the speed of rotation of said spindle and mounted first part and simultaneously moving said holder towards said spindle to forcibly urge said first and second parts together at said contacting surfaces, and

d. stopping rotation of said spindle and mounted first part at a specific determined angular axial orientation of said first part relative to said second part while still forcibly urging said first and second parts together to allow cooling and fused solidification of said contacting surfaces.

2. The method of claim 1 wherein step b includes bringing said first and second parts into frictional contact at a first pressure force with the combined axial length of said first and second parts being reduced a specific distance followed by a second pressure force greater than said first pressure force with the combined axial length of said first and second parts being further reduced a second specific distance while maintaining said first desirable speed.

3. The method of claim 2 wherein step c also includes applying a third pressure force greater than said second pressure force to said first and second parts with the combined axial length of said first and second parts being reduced a third specific distance.

4. The method of claim 3 including monitoring the angular axial orientation of said first part relative to said second part during steps a, b, c, and d.

5. The method of claim 4 wherein step d includes applying a forge force to said first and second parts for a specific dwell time.

6. The method of claim 1 including determining responsive to one or more material characteristics of said first and second parts said desirable speed, said one specific time, and amount of force utilized to so force said first and second parts together during rotation of said spindle and mounted first part.

7. The method of claim 1 including monitoring said angular axial orientation of said second part of said first and second parts relative to each other and adjusting the rotational speed of said spindle to arrive at said specific determined angular axial orientation of said first part relative to said second part.

8. The method of claim 1 including adjusting the rotational speed of said spindle during steps b to effect said melting of the contacting surfaces of said first and second parts.

9. A method of using a friction welding machine to weld a pair of workpieces together at a desired final angular orientation relative to each other, the friction welding machine including a rotatable spindle and a non-rotatable tailstock, the method comprising the steps of:

calculating a set of weld parameters used to control the friction welding machine, the set of welding parameters including a desired spindle speed and a desired spindle position;

mounting a first one of the pair of workpieces to the rotatable spindle and a second one of the pair of workpieces to the non-rotatable tailstock;

rotating the rotatable spindle;

monitoring at least one of an actual spindle speed and an actual spindle position to produce a measurement;

comparing the measurement with at least one of the desired spindle speed and desired spindle position;

adjusting at least one of the actual spindle speed or the actual spindle position so that the actual spindle position is substantially similar to the desired spindle position; and

bringing the pair of workpieces into frictional contact with each other to generate a weld such that the workpieces are welded together in the desired final angular orientation relative to each other.

10. The method according to claim 9, wherein the method includes the step of:

repeating the monitoring, comparing, and adjusting steps until the actual spindle speed equals the desired spindle speed of zero.

11. The method according to claim 9, wherein the welding machine includes a computing device, and wherein the calculating step comprises:

entering a set of input parameters into the computing device, the input parameters including the desired final angular orientation between the pair of

workpieces and the physical characteristics of the pair of workpieces.

12. The method according to claim 9, wherein the calculating step comprises generating a spindle profile curve from the calculated set of weld parameters.

13. The method according to claim 12, wherein the spindle profile curve includes a plurality of phases, the spindle profile curve further being indicative of at least one of the desired spindle speed or the desired spindle position at one of a plurality of time intervals within the phases.

14. The method according to claim 13, wherein the rotating step comprises:

positioning the rotatable spindle in a desired initial angular position; and

rotating the rotatable spindle so that the actual spindle speed for a current one of the phases is substantially equal to the desired spindle speed for the current phase.

15. The method according to claim 13, wherein the rotating step comprises:

wherein each of the phases, adjusting the actual spindle speed of the rotatable spindle so that the desired spindle speed for each of the phases is substantially equal the desired spindle speed of each of the phases.

16. The method according to claim 13, wherein the rotating step during a last one of the phases includes the step of slowing the rotation of the rotatable spindle until the actual spindle speed equals zero.

17. The method according to claim 9, wherein the comparing step comprises:

monitoring either the actual spindle position of the rotatable spindle or the

actual spindle speed periodically.

18. The method according to claim 9, wherein the friction welding machine includes a controller, and including the steps of:

calculating a difference between the actual spindle position and the desired spindle position;

communicating the difference to the controller; and

adjusting the actual spindle position to minimize the difference.

19. The method according to claim 9, wherein the adjusting step comprises:

utilizing the comparison between the actual spindle position and the desired spindle position at a particular time point to determine the required adjustment to the actual spindle speed.

20. The method according to claim 9, wherein the bringing into frictional contact step comprises:

moving the non-rotatable tailstock towards the rotatable spindle according to the set of weld parameters.

21. The method according to claim 9, wherein the bringing into frictional contact step comprises:

contacting the first one of the pair of workpieces to a second one of the pair of workpieces; and

generating heat at a contact surface formed between the pair of workpieces

22. An apparatus for controlling a friction welding machine, comprising:

a motion controller;

a position sensor; and

a computing device for accepting the entry of input parameters, the

computing device operatively coupled to the motion controller and the position sensor; wherein

the computing device being programmed to (i) calculate a set of weld parameters from input parameters, wherein the weld parameters include a desired spindle speed and desired spindle position, (ii) cause the motion controller to produce a command signal indicative of a desired spindle speed calculated from a set of input parameters, (iii) receive a status signal from the position sensor indicative of an actual spindle position at a specific time point, (iv) compare the actual spindle position to the desired spindle position calculated from the set of input parameters at the specific time point, and (v) cause the motion controller to deliver a difference signal to make any necessary corrections to the rotational speed.

23. The apparatus according to claim 22, wherein the friction welding machine is comprised of a rotatable spindle and a drive motor, and wherein the motion controller generates a motion command and communicates the motion command signal to the drive motor that drives the rotatable spindle so that the rotatable spindle rotates.

24. The apparatus according to claim 22, wherein the position sensor includes a tachometer for measuring the speed of the rotatable spindle..

25. The apparatus according to claim 22, wherein the computing device is operatively coupled to the motion controller and position sensor so that the computing device can compare the status signal from the position sensor to the calculated weld parameters and deliver a motion command signal to the drive motor to make a correction to the actual spindle speed or actual spindle position.